Claims

We claim:

1. A variable stiffness malleable shaft comprising:

a plurality of generally prismatic shaft elements adjacent one another, each having:

a first longitudinal axis;

a plurality of axial through holes;

a recess formed in a proximal end of the shaft element, the recess defined along a second axis transverse to the first longitudinal axis; and

a protrusion formed in a distal end of the shaft element, the protrusion defined along a third axis transverse to the longitudinal axis, wherein the second and third axes are oriented relative to one another such that the respective axial through holes of adjacent like shaft elements are aligned with one another when a protrusion of one shaft element is aligned with a recess in an adjacent like shaft element; and

at least one tension element secured to a distal end of the malleable shaft and in communication with a proximal end of the malleable shaft via an axial through hole.

2. The variable stiffness malleable shaft according to claim 1 further comprising at least one remote apparatus located at a distal end of said shaft.

3. The variable stiffness malleable shaft according to claim 2, wherein said at least one remote apparatus is articulated via a central passage formed in said flexible malleable shaft.

4. The variable stiffness malleable shaft according to claim 2, wherein said at least one remote apparatus is selected from the group comprised of a clamp, a scissors, a retractor, a stabilizer, a ligator, an ablator, and an endoscope.

5. The variable stiffness malleable shaft according to claim 1, wherein said shaft elements further comprise a central axial through hole, positioned such that the central axial through holes of adjacent shaft elements are aligned with one another

when a protrusion of one shaft element is aligned with a recess in an adjacent like shaft element.

6. The variable stiffness malleable shaft according to claim 1, wherein, in at least one of said shaft elements, at least one of said recess and said protrusion comprises a friction enhancement means.

7. The variable stiffness malleable shaft according to claim 6, wherein said friction enhancement means comprises at least one of a friction enhancing material, and a friction enhancing geometry.

8. The variable stiffness malleable shaft according to claim 1 further comprising a base section adapted for securement to additional surgical hardware.

9. The variable stiffness malleable shaft according to claim 1, wherein said second and third transverse axes are oriented at 90 degrees to one another.

10. The variable stiffness malleable shaft according to claim 9, wherein said plurality of axial through holes comprises four axial through holes distributed approximately 90 degrees from one another about said first longitudinal axis.

11. The variable stiffness malleable shaft according to claim 1, wherein said second and third transverse axes are oriented approximately 120 degrees to one another.

12. The variable stiffness malleable shaft according to claim 11, wherein said plurality of axial through holes comprises three axial through holes distributed approximately 120 degrees from one another about said first longitudinal axis.

13. The variable stiffness malleable shaft according to claim 1, further comprising a plate mounted to articulate about a point in space, and connected to said tension element.

14. An element for use in a variable stiffness malleable shaft comprising, the element comprising:

a generally prismatic body defining a first longitudinal axis;

a plurality of axial through holes;

a recess formed in a proximal end of the element, the recess defined along a second axis transverse to the first longitudinal axis; and

a protrusion formed in a distal end of the element, the protrusion defined along a third axis transverse to the longitudinal axis, wherein the second and third axes are oriented relative to one another such that the axial through holes of adjacent elements are aligned with one another when a protrusion of one shaft element is aligned with a recess in an adjacent shaft element.

15. A variable stiffness malleable shaft comprising:

a plurality of tension elements, each being connected at its distal end to a distal end of the malleable shaft;

a compensation element mounted to articulate about a point in space, wherein each tension element is connected at its proximal end to the compensation element;

an actuator for applying force to the plurality of tension elements; and

a connector linking the compensation element to the actuator.

16. The variable stiffness malleable shaft according to claim 15, wherein the plate is mounted on a ball joint, said ball joint located at one end of said connector.

17. The variable stiffness malleable shaft according to claim 15, wherein said plate comprises a clearance passage.

18. A variable stiffness malleable shaft comprising:

a first pair of tension elements, each tension element connected at its distal end to a distal end of the malleable shaft and at its proximal end to the other tension element of the first pair;

a fulcrum having a distal side and a proximal side, wherein the joined proximal ends of the tension element pass over a proximal side of the fulcrum;

an actuator for applying force to the plurality of tension elements; and

a connector linking the fulcrum to the actuator.

19. The variable stiffness malleable shaft according to claim 18, wherein the fulcrum is generally spherical.

20. The variable stiffness malleable shaft according to claim 19, wherein the fulcrum further comprises a channel in its proximal side for accommodating the pair of tension elements.

21. The variable stiffness malleable shaft according to claim 20, wherein the channel is substantially aligned with a great circle of the spherical fulcrum.

22. The variable stiffness malleable shaft according to claim 18, wherein the fulcrum further comprises a channel in its proximal side for accommodating the pair of tension elements.

23. The variable stiffness malleable shaft according to claim 18, further comprising a second pair of tension elements, each tension element connected at its distal end to a distal end of the malleable shaft and at its proximal end to the other tension element of the second pair.

24. The variable stiffness malleable shaft according to claim 23, wherein the fulcrum further comprises a first channel and a second channel in its proximal side for accommodating the first pair and the second pair of tension elements.

25. The variable stiffness malleable shaft according to claim 24, wherein said second channel is formed deeper in the fulcrum than said first channel.

26. The variable stiffness malleable shaft according to claim 24, wherein said first channel and said second channel cross on a proximal side of said fulcrum.